

# NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering  
Materials Laboratory Division  
Washington, D.C. 20594



July 8, 2003

## MATERIALS LABORATORY FACTUAL REPORT

Report No. 03-054

### A. ACCIDENT

Place : Everglade City, Florida.  
Date : December 30, 2002  
Vehicle : Tour boat "Panther".  
NTSB No. : DCA03MM018  
Investigator : Robert Ford

### B. COMPONENTS EXAMINED

Strut block pieces.

### C. DETAILS OF THE EXAMINATION

Portions of the vessel's strut block pieces were received for examination and are illustrated in figure 1. The portions are identified as blocks "A", "B" and "C". Preliminary examination revealed that block "A" consisted of a single piece of wood approximately 11" x 8" x 1" thick. Block "B" consisted of a piece of plywood approximately 9" x 7" x  $\frac{7}{8}$ " thick. Block "C" consisted of the 10 variously shaped pieces individually numbered as in figure 1.

In order to illustrate the original location of the received portions on the vessel the isometric sketch illustrated in figure 2 was produced. The strut blocks "A", "B" and "C" are located between the upper strut plate (a metal plate on which the rudder cylinder is also mounted) and the hull planking. A lower strut plate (a metal plate to which the upper end of the propeller shaft bearing support is attached) is located below the hull planking and is, therefore, submerged when the vessel is in use. The lower end of the propeller shaft bearing support is attached to an extension of the keel. The rudder is located to the rear of the propeller, between the hull planking and the keel extension.

#### Strut block "A".

Examination of block "A" revealed that it was a single piece of wood that was resistant to penetration by a fingernail and had an odor as if it had been treated with creosote. One fractured edge displayed two partial through holes and there were two small holes through the thickness. There was a third through thickness hole that was filled with a hard translucent green plastic material. A knot on one surface was pried loose with a fingernail to reveal that the underlying material was a matt black color. One surface of

block "A" is illustrated in figure 3 with the green arrows indicating the partial holes and the red and blue arrows indicating the through holes. The white arrow indicates the hole filled with the green material and the yellow arrow indicates the location of the knot.

#### Strut block "B".

Block "B" was a piece of plywood that was falling apart especially at the edges and displayed a brown coloration on exposed surfaces. A fingernail pressed on to a surface would leave an indentation. The examination revealed a hard translucent tan material along one edge and two hexagonal shapes that protruded from one surface. This surface is illustrated in figure 4 with the red arrow indicating the end of the tan material and the white and yellow arrows indicate the hexagonal shapes. The discoloration and deterioration of one edge of this block is evident in figure 4.

The end of the translucent tan material, indicated by the red arrow in figure 4, is similarly indicated in figure 5. As illustrated, the translucent material was "T" shaped and was located on the upper surface of the block and partially down the edge. The thickness of the portion on the surface reduced as its distance from the edge increased, and the portion on the edge displayed a rounded tip. Elevation of a thin portion on the surface revealed that the material was brittle. The blue arrows indicate a blue coating on the tan material and the yellow arrow indicates a rough textured tan coating on top of the blue coating. The discoloration and deterioration of the plywood is evident on the illustrated edge in the foreground of figure 5.

Examination of the hexagonal shape indicated by the white arrow in figure 4 revealed that it was a nut on top of a 1/2-inch thickness of washers. The number of washers could not be determined due to the amount of hard encasing material. At the interface with the plywood surface there was a thin white layer. The encased nut and washer assembly was elevated to reveal that the white layer covered the underside of the lowest washer and the diameter of the bolt the nut was attached to. The left view of figure 6 illustrates the hexagonal shape indicated by the white arrow in figure 4. The yellow arrow indicates the nut and the blue arrow indicates the washers. The white arrow indicates a circular depression suggestive of the interface between the bolt thread and the nut. The green arrows indicate the white layer. The right view of figure 6 illustrates the underside of the lowest washer and the bolt shank. The green arrows, as in the left view, indicate the white layer, the red arrow indicates the corroded bolt shank and the yellow arrow indicates more of the white material around the bolt shank.

The hexagonal shape indicated by the yellow arrow in figure 4 is illustrated in figure 7. The yellow arrow indicates the misshaped edges of the nut, and the white arrow indicates a circular depression suggestive of the interface between the bolt thread and the nut. The red arrows indicate a crack in the material that coated the nut and the adjacent plywood surface, which had propagated around the nut.

Examination of the other side of block "B", see figure 8, revealed more deterioration to the plywood. The white arrow in figure 8 indicates the protruding remains of a bolt shank that was attached to the nut indicated by the white arrow in figure 4. Also, the green arrow in figure 8 indicates where the broken shank of the bolt that was attached to the nut

indicated by the yellow arrow in figure 4 was located just below the block surface. Some of the plywood surface was covered with what appeared to be a blue/gray translucent material with an average thickness of  $\frac{1}{16}$ -inch. Examination revealed that some of this material was dark brown on the inside and some was a tan color. A uniform  $\frac{1}{16}$ -inch layer of a dark tan material was exposed between the plies at one corner. The red and blue arrows in figure 8 indicate areas where the inside of the surface covering was dark brown and the black arrow indicates where the inside was tan colored. Both the dark brown and the tan colored materials were hard and broke easily when bent.

A layer of what appeared to be hard, dark tan plastic was found approximately in the center of the plies of the plywood. This plastic layer is indicated by the yellow arrow in figure 8 is similarly indicated in figure 9. As illustrated in figure 9, there were three wood plies located above the dark tan material and four plies located below it. The material was of uniform thickness and appeared to continue into the block and along the fractured edge illustrated in figure 8. The deterioration of the plywood is evident in the illustrated plies.

#### Strut block "C" pieces.

Block piece "C1" displayed the same basic color as the other pieces identified as being from block "C". A fingernail could penetrate the surface and the dark brown edges.

Block piece "C2" was predominantly a piece of wood with soft edges, but one side displayed a hard green material that could not be penetrated by a fingernail. The affected side is illustrated in figure 10 with the green material outlined by the yellow dashed line.

Block pieces "C3", "C4" and "C5" were similar to block piece "C1".

Block piece "C6" appeared to be similar to the other pieces but one side was covered with an off white paint. The painted surface is illustrated in figure 11 with the blue and red arrows indicating other features illustrated in figures 12 and 13. The green arrow indicates an area that felt "rubbery" and when the reverse side was examined it was found that the rubbery area extended to the reverse side, appearing similar to the area within the yellow dashed lines in the right view of figure 13.

The blue and red arrows in the left view of figure 12 indicate the features similarly indicated in figure 11. The blue arrow indicates the end of a sliver of a white material that appeared to go under the painted surface and towards the feature indicated by the red arrow. The material was approximately  $\frac{1}{4}$ -inch wide, and as can be seen adjacent to the blue arrow in figure 11, it had varying depths. It was easily bent and returned to its original location when released. The feature indicated by the red arrow in the left view of figure 12 is illustrated, at a higher magnification, in the right view. The material indicated by the red arrow was also white and felt similar to the material indicated by the blue arrow in the left view. It appeared to be a tubular protrusion of approximately  $\frac{3}{4}$ -inch outside diameter. The material appeared to have been poured around a bolt, leaving a casting of the bolt threads on the inside diameter of the tubular protrusion. The threads are indicated by the yellow arrow.

The deterioration of the wood is displayed in the left view of figure 13, which is the opposite surface to that illustrated in the left view of figure 12. The blue arrow indicates the white elastomeric material similarly indicated in the left view of figure 12. The red arrow indicates the other side of the feature similarly indicated in the left view of figure 12 and illustrated in the right view of figure 12. The feature indicated by the red arrow is illustrated, at a higher magnification, in the right view. The yellow arrow indicates the threads, as in the right view of figure 12, and the yellow dashed line indicates the periphery of the material. The white arrow indicates a hole filled with a hard translucent green material similar to that indicated by the white arrow in figure 3.

Block piece "C7" consisted almost entirely of a flexible white material similar to the material indicated by the blue arrows in figures 11, 12, and 13 for piece "C6". Some wood fibers were still attached. The left view of figure 14 illustrates the white material and the right view shows the wood fibers and the other features on its reverse side. The red arrow indicates a tubular portion of the white material that had been cast around the threaded portion of a bolt, and the yellow arrows indicate a solid cylinder of white material approximately 1" tall. The white arrow in the right view of figure 14 indicates a sliver of wood.

Block piece "C8" consisted of wood with one surface displaying the white paint and a cream colored elastomeric coating as illustrated in the left view of figure 15. The right view illustrates the opposite surface with the red and yellow arrows indicating small cylinders of an elastomeric material similar to that previously described.

Block piece "C9" appeared to be a rectangular block of a hard translucent green material with wood fibers attached. The left view of figure 16 illustrates the piece with one end displaying the green material also indicated by the green arrow. The yellow arrow indicates a portion of the same end that appeared to consist of a dark brown material. A closer view of the end is illustrated in the right view of figure 16 with the green and brown materials similarly indicated. The yellow dashed line indicates the upper semi-circular edge of the trough indicated by the red arrow. The trough penetrated through the piece suggesting that the green material had been cast around the shank of a bolt.

The exterior of block piece "C10" appeared to consist of a gray flaky material that was easily reduced to small particles by a rubbing action. When broken at the yellow dashed line indicated in the left view of figure 17, the interior displayed the swirled dark and light gray layers illustrated in the right view of figure 17.

#### Material determination.

Blocks "A", "B", "C2" and "C6" were shipped to the USDA Forest Products Laboratory for identification of the wood and determination of the type of decay observed. Block "A" was identified as bald cypress, which is quite resistant to decay. The softer material at the edges was determined to be either brown rot or soft rot fungi and the odor was consistent with a creosote treatment. The decay on block "B" was determined to be brown rot fungi, which was so intense that identification of the woods utilized in the plywood was not possible. Blocks "C2" and "C6" were determined to be southern yellow pine and the decay was brown rot fungi. Numerous cross grain cracks appeared when a sharp instrument was

applied to the wood, symptomatic of brown rot decay. The odor was consistent with a creosote treatment. Microscopic examination of decayed areas revealed the absence of the ray parenchyma cells, a symptom of brown rot decay. The cells provide food materials for the fungi and are absent in decayed wood.

Derek Nash  
Mechanical Engineer



ImageNo:301A0766, Project No:A00473

Figure 1. Pieces of the wooden strut blocks received for examination.

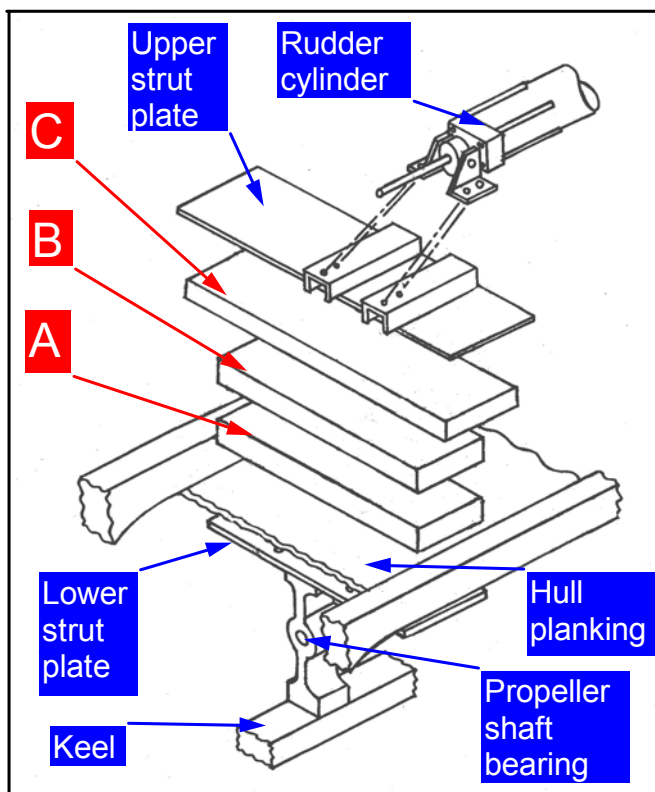
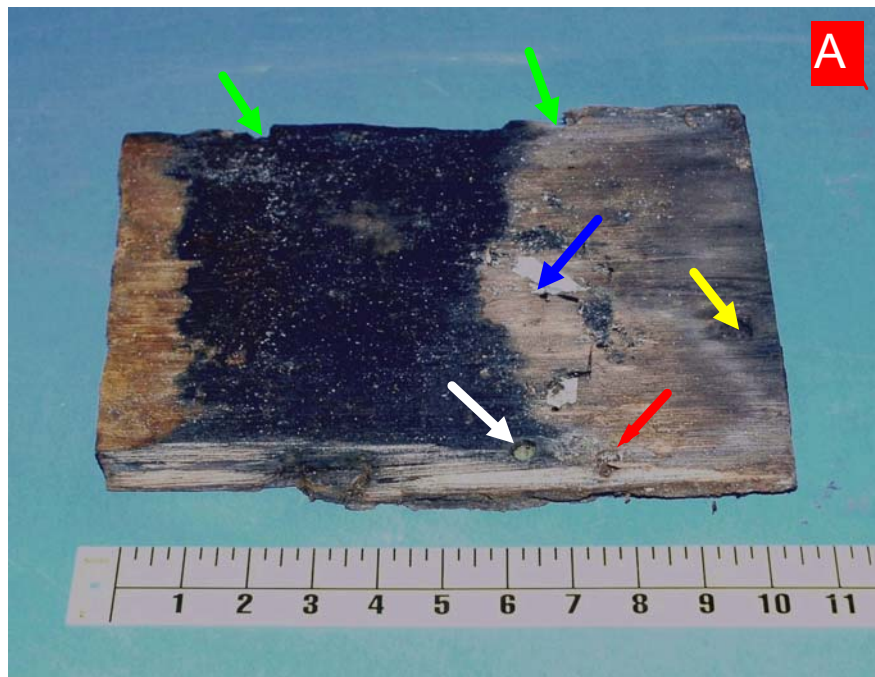


Figure 2. Schematic illustrating the location of the vessel's strut blocks.

ImageNo: 305A0450, Project No:A00473



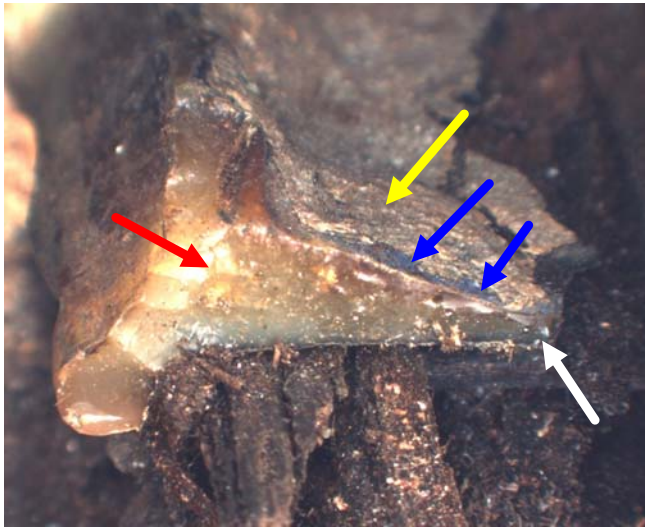
ImageNo:301A0786, Project No:A00473

Figure 3. One surface of the strut block identified as "A" in figure 1.



ImageNo: 301A0764, Project No:A00473

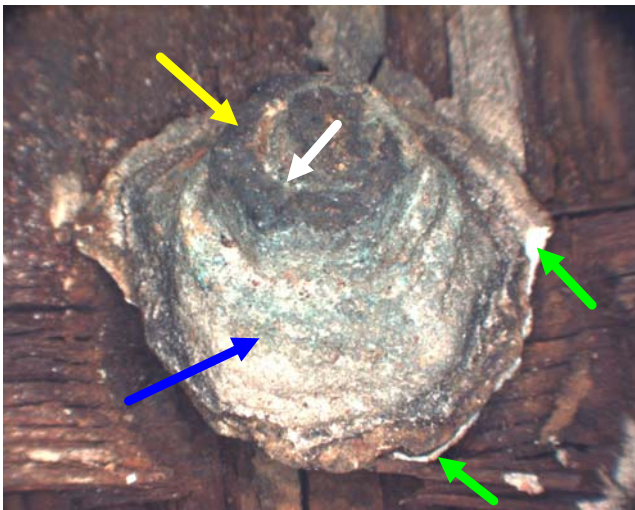
Figure 4. One surface of the strut block identified as "B" in figure 1.



ImageNo:305A0434, Project No:A00473

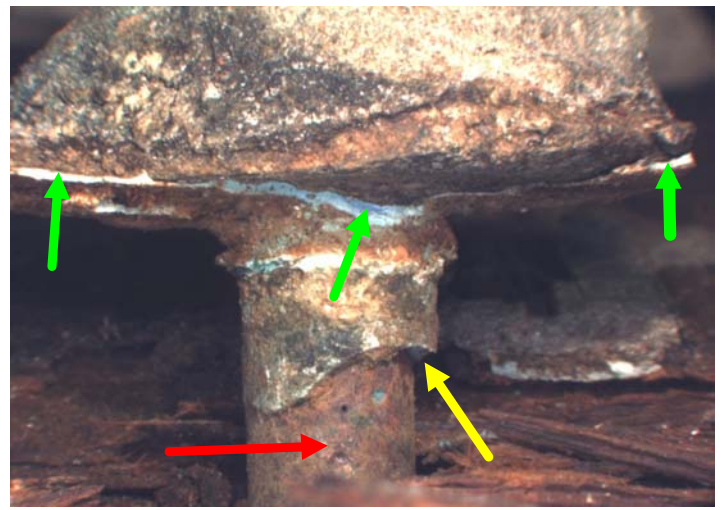
— 5 mm —

Figure 5. The feature indicated by the red arrow in figure 4.



ImageNo: 305A0430, Project No:A00473

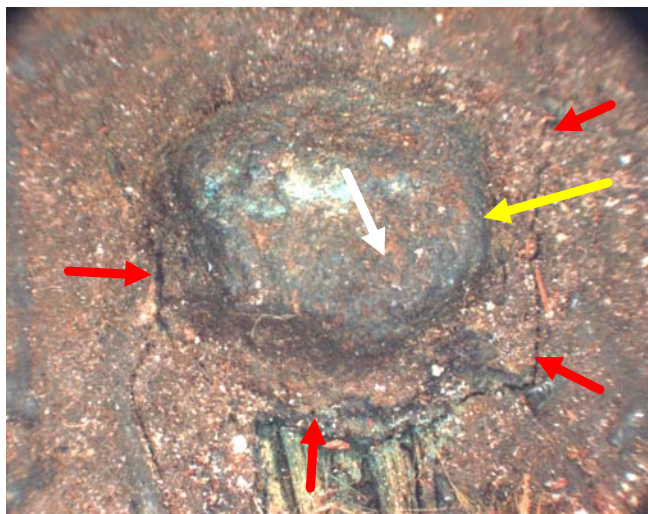
— 10 mm —



ImageNo:305A0438, Project No:A00473

— 5 mm —

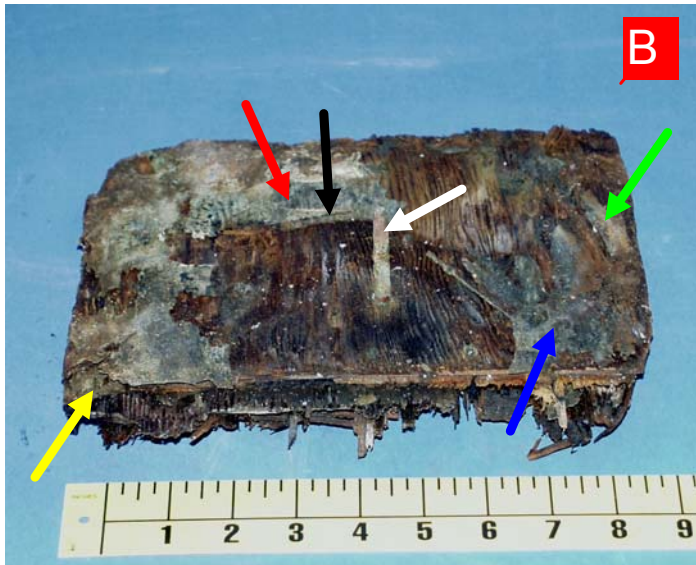
Figure 6. The feature indicated by the white arrow in figure 4 (left view) and the underside of the same feature (right view).



ImageNo:305A0432, Project No:A00473

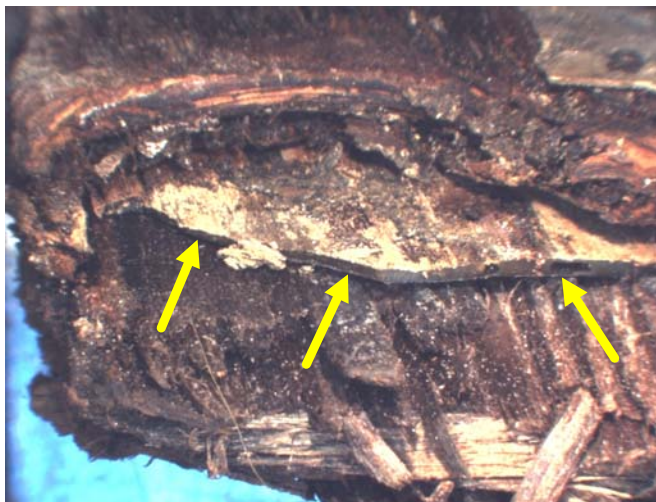
— 5 mm —

Figure 7. The feature indicated by the yellow arrow in figure 4.



ImageNo:301A0762, Project No:A00473

Figure 8. The other side of strut block "B" illustrated in figure 4.



ImageNo: 305A0435, Project No:A00473 | 10 mm |

Figure 9. The feature indicated by the yellow arrow in figure 8.

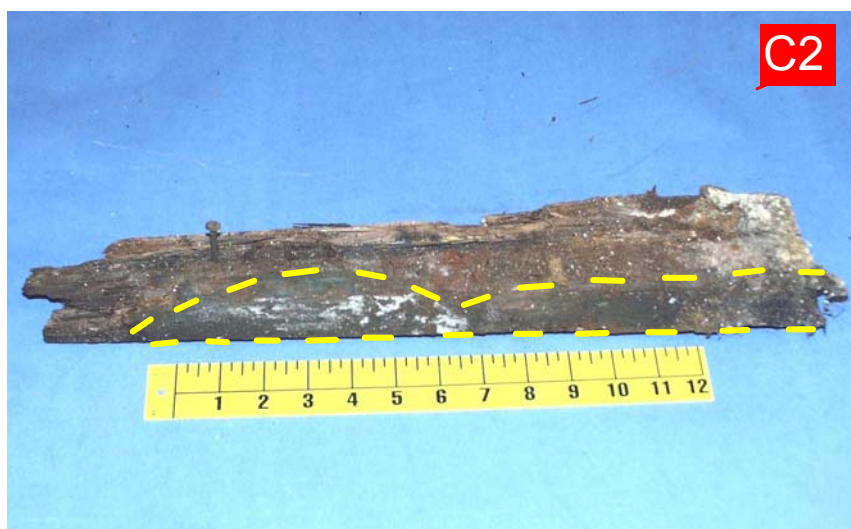


Figure 10. The strut block piece identified as "C2" in figure 1.

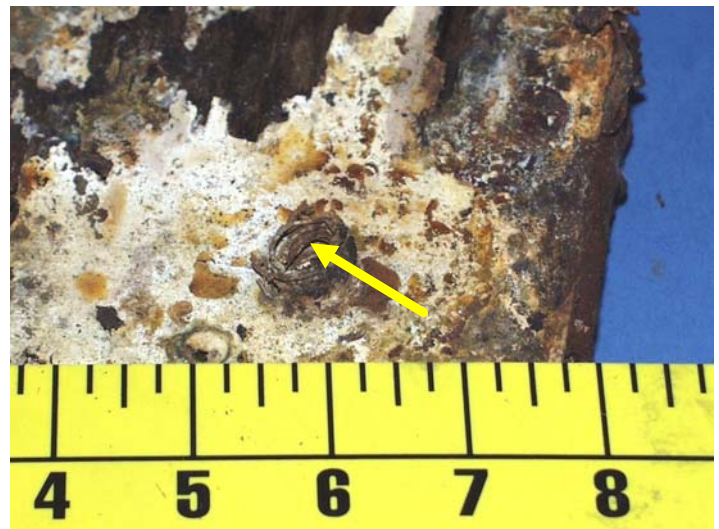


ImageNo:301A0518, Project No:A00473

Figure 11. The strut block piece identified as "C6" in figure 1.



ImageNo: 301A0778, Project No:A00473

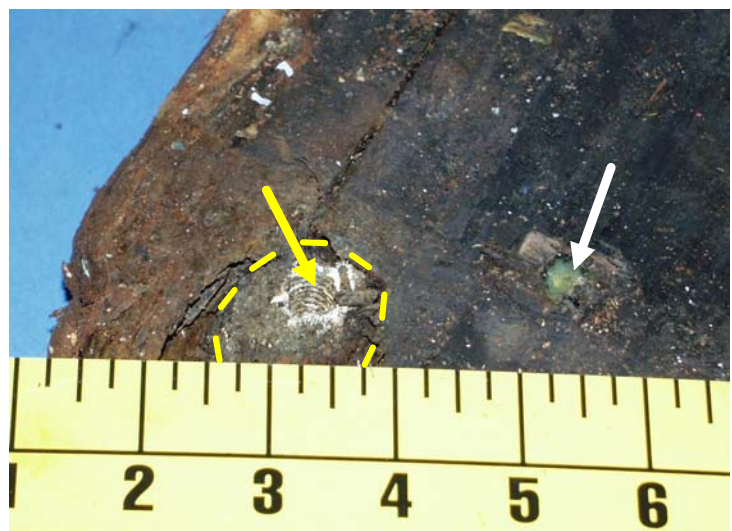


ImageNo: 301A0780, Project No:A00473

Figure 12. A view of the left end (left view) of strut block "C6", as illustrated in figure 11 and a closer view of the feature indicated by the red arrow (right view).



ImageNo:301A0782, Project No:A00473

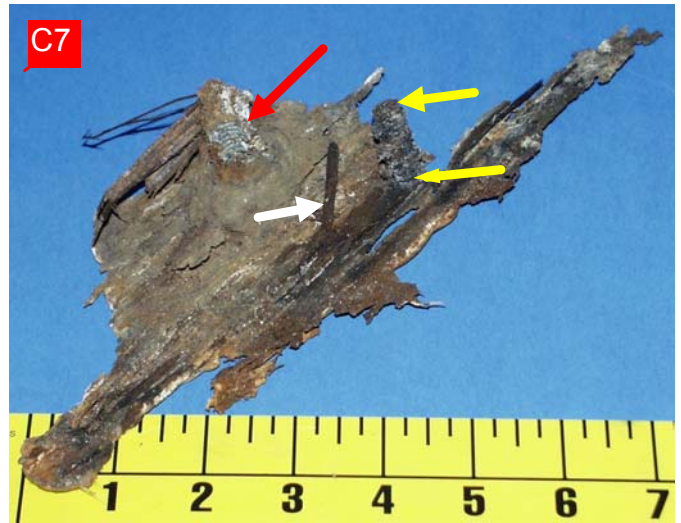


ImageNo:301A0783, Project No:A00473

Figure 13. Underside views of the strut block features illustrated in figure 12.



ImageNo:301A0769, Project No:A00473

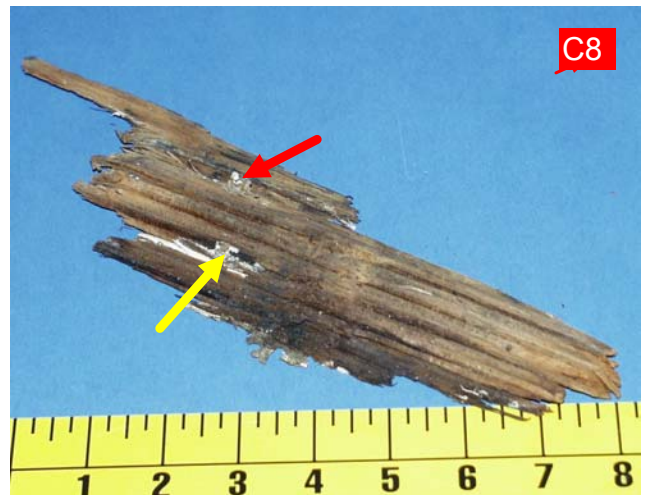


ImageNo: 301A0768, Project No:A00473

Figure 14. Both sides of the piece of strut block identified as "C7" in figure 1.



ImageNo:301A0771, Project No:A00473

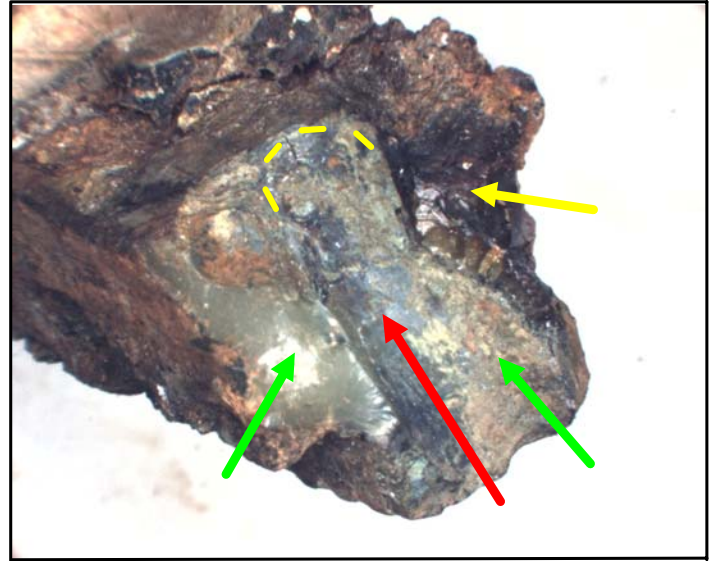


ImageNo:301A0770, Project No:A00473

Figure 15. Both sides of the piece of strut block identified as "C8" in figure 1.



ImageNo:301A0775, Project No:A00473



ImageNo: 305A0446, Project No:A00473

10 mm

Figure 16. The piece of strut block identified as "C9" in figure 1 (left view) and a closer view of the end indicated by the green arrow (right view).



ImageNo:301A0773, Project No:A00473



ImageNo:305A0444, Project No:A00473

10 mm

Figure 17. The piece of strut block identified as "C10" in figure 1 (left view) and a closer view of its internal structure (right view) when broken open at the yellow dashed line in the left view..